

## Contents

Pages 1 and 4:  
Improving patient safety  
through human factors  
engineering and usability  
testing

Page 2 and 3:  
Are prescription labels  
understood by our  
Veterans? A snapshot of  
results from a new study

## VA National Center for Patient Safety

P.O. Box 486  
Ann Arbor, MI 48106-0486

Phone: ..... (734) 930-5890

Fax: ..... (734) 930-5877

E-mail: ..... NCPS@va.gov

### Web Sites:

Internet: ..... www.patientsafety.gov

Robin R. Hemphill, M.D., M.P.H.  
Deputy Chief Patient Safety Officer  
Director, VA National Center  
for Patient Safety

### Editor

Joe Murphy, M.S., A.P.R.  
Public Affairs Officer

Graphic Design and Copy Editing  
Deborah Royal  
Visual Information Specialist

TIPS is published bimonthly  
by the VA National Center for  
Patient Safety. As the official  
patient safety newsletter of the  
Department of Veterans Affairs, it  
is meant to be a source of  
patient safety information for  
all VA employees. Opinions of  
contributors are not necessarily  
those of the VA. Suggestions and  
articles are always welcome.

Thanks to all contributors and  
those NCPS program managers  
and analysts who offered their  
time and effort to review and  
comment on these TIPS articles  
prior to publication.

## Improving patient safety through human factors engineering and usability testing

*By Judith Anderson, M.D., NCPS patient safety physician 2007-2011*

Human factors engineering (HFE) is a discipline used to study the mental and physical capabilities, characteristics, and limitations of humans. It is used to design tools and systems to improve performance and avoid errors. This is of particular importance in an increasingly complex health care environment.

Well designed systems and devices can decrease mental and physical workload, make tasks more efficient, save time, guide correct use, and reduce training requirements. Poor designs can increase workload and stress, waste time, give incorrect or no cues for actions, cause confusion, lead to work-arounds and skipped steps, or cause other problems that can compromise patient safety.

Human traits/abilities, vision, concentration, dexterity, memory, and hearing all have limitations. But even when stressed or fatigued, health care professionals must be able to:

- Constantly call upon their clinical knowledge base and keep track of all of their duties
- Care for the patient and always be aware of their condition and any changes
- Answer questions, alarms, phone calls
- Remember the correct steps and sequence of the many tasks they need to perform

All of this is conducted, much of the time, in a busy, confusing, noisy and sometimes chaotic environment. Adding poorly designed systems, devices, equipment, or care areas into the equation only increases the likelihood of errors.

Examples of attempts to help health care professionals compensate for human limitations are now routinely found in hospitals.

- *Hand hygiene.* Many of us can recall when there were only sinks inside patient rooms or at the nursing stations. We had to remember to perform hand hygiene every time we entered a room, often having to go out of our way to find a sink. Alcohol hand gel is easy and quick to use. Simply locating hand gel dispensers on the door of each patient room is convenient and, because it gives a visual cue, helps remind us to sanitize our hands before entering. And such placement does not force caregivers to step out of a normal work flow to look for a sink or a poorly located dispenser.
- *Checklists,* which have become ubiquitous in health care, can be one solution to the high cognitive load that modern medicine imposes upon the caregiver. Only so many items can be stored in the working memory of humans. Checklists ease the need to remember every single step of a task.

- *Procedure kits* are now being designed that contain all of the equipment needed to perform certain tasks. Many have the material arranged in the sequence of recommended use. Using kits means we do not need to spend valuable time gathering equipment—or find it laid out in no particular order when ready for use.

In these three examples, we can see how HFE can be used to help design products and environments that help professionals perform the right task at the right time and in the right way.

Even these systems, however, can be improved. Additional cues can be provided for hand hygiene by adding more point-of-care dispensers. New systems are also now available that have enhanced visual, auditory and vibratory reminders.

Not all checklists are equally effective. Many things go into the design of an effective checklist, such as phrasing/vocabulary, size, color, contrast, font, orientation, and length. (Important design features for checklists can be found on three Web sites noted at the end of this article.) Checklists are important, but should not be considered the solution to every problem.

In terms of kits, HFE principles may have been a consideration in their design or not—and design flaws may not come to light until they result in safety issues. Some kits have the components out of order, while others may give confusing cues to the user. In recent usability tests of two Foley catheter insertion kits by experienced nurses, both kits were found to contain everything needed for insertion. But one kit was designed with the equipment in the proper sequence for preparation and insertion—virtually walking the user through the procedure correctly—while the other kit had some components out of order and additional confusing cues.

### Task observation and analysis

Sometimes simple observation can help find the flaws in a design. For instance, the source of infections in one ICU was found by observing how tasks were carried out. Excess water pressure and shallow sinks located near the “clean area” in one room allowed contaminated water to splash out on “clean” items that were to be used for patient care.

In another example, observation in hospitals revealed that a BioPatch was sometimes being applied on the wrong side because the “up” side (the light blue side) was not obvious. Reports to the manufacturer resulted in a design change that made the correct side very clear to caregivers. This is an example of how a good redesign can make it easier for health care professionals to do the right thing.

# Are prescription labels understood by our Veterans? A snapshot of results from a new study

Keith W. Trettin, NCPS program manager and principle investigator for the survey

The VA prescription benefit is one of the most frequently used by our Veterans. More than 4.6 million Veterans use this benefit and the number is growing by 3 percent per year. The VA filled more than 136 million prescriptions for Veterans in fiscal year 2010, at a cost of approximately \$3,284 million. In support of the prescription benefit, the VA employs more than 7,000 pharmacists and 4,000 pharmacy technicians.

When Veterans understand how to take their medications correctly, they have improved medical outcomes and their total health care costs decrease.<sup>1,2</sup> NCPS has received many cases via root cause analysis findings and safety reports in which Veterans misinterpreted their prescription labels and subsequently had a poor clinical outcome. For example, Veterans have often misunderstood labels for diabetes medication that read, “Take two tablets by mouth twice a day (half-an-hour before a meal)” to mean the medication should be taken *before every meal—or—three times a day*. This has resulted in patients experiencing hypoglycemia.

Studies have shown that depending on their literacy level, 25-to-88 percent of patients cannot correctly state how to take their medications.<sup>3,4</sup>

To better understand how the information on each label was being interpreted, NCPS conducted a national study, in conjunction with VA Pharmacy Benefits Management Services, in which Veterans played a key part: “Improving Veteran health-literacy and safety through implementation of a novel, evidence-based, patient-centered outpatient prescription label.”

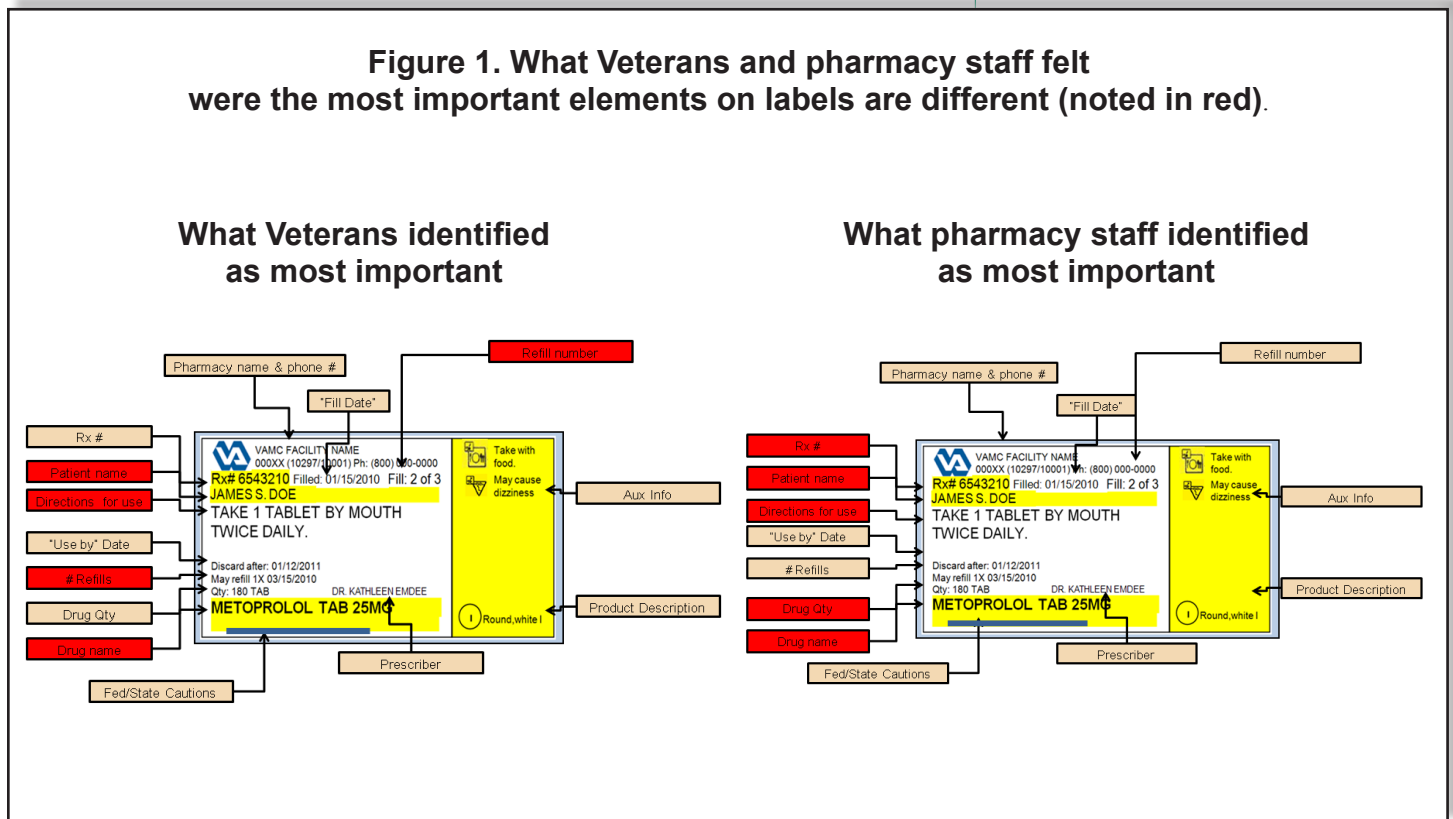
The project evaluated Veterans’ literacy with current VA prescription labels, as well as comprehension and satisfaction with a proposed new patient-centric label, using an evidence-based, patient-centric evaluation model. Four-hundred-forty-six Veterans at 11 survey sites and 697 VA pharmacy staff participated in the study. The goal was to provide evidence that a standardized patient-centric label can increase each Veteran’s understanding of how to take his or her medications.

Some of the highlights are shown in Figures 1 through 3:

## References

1. Ho, P. M., et al. (2007). Medication nonadherence is associated with a broad range of adverse outcomes in patients with coronary artery disease. *American Heart Journal*, 155(4), 772-779.
2. Roebuck, M.,C., Liberman, J., N., Marin Gemmill-Toyama, M., & Brennan, T., A. (2011). Medication Adherence Leads To Lower Health Care Use And Costs Despite Increased Drug Spending. *Health Affairs*, 30(1), 91-99.
3. Williams, M.,V., et al. (1995). Inadequate functional health literacy among patients at two public hospitals. *JAMA*, 274(21), 1677-1682.
4. Wolf, M.S., et al. (2006) Literacy and misunderstanding of prescription drug labels. *Annals of Internal Medicine*, 145(12), 887-94.

**Figure 1. What Veterans and pharmacy staff felt were the most important elements on labels are different (noted in red).**



**Figure 2. How we ask a Veteran to take one-half of a tablet makes a difference**

#33

<b>METOPROLOL TAB 25MG</b>	Take with food. May cause dizziness
TAKE 1/2 TABLET BY MOUTH IN THE MORNING AND IN THE EVENING	Fill 2 of 3 Filled 01/15/2010 Use by: 01/12/2011
<b>JANE S. DOE</b>	Refills Left: 1
Rx# 6543210	Qty: 180 TAB
DR. KATHLEEN EMDEE	VAMC FACILITY NAME 000XX (10297/10001) Ph: (800) 000-0000
	(1) Round, white 1

How many pills would you take for one dose (for example, in the morning)?

A VA cost-saving initiative asked Veterans to split medication in half: 88-80 percent understood how to take one-half of a tablet. Using the combination of a fraction and verbiage on the label was found to be the most effective way to communicate this.

<b>Take 1/2 (one-half) tablet by mouth...</b>	<b>88 percent gave the correct response</b>
<b>Take one-half tablet by mouth...</b>	<b>86 percent</b>
<b>Take 1/2 (12.5 mg) tablet...</b>	<b>82 percent</b>
<b>Take 1/2 tablet by mouth...</b>	<b>80 percent</b>

The results of Veteran preferences were incorporated into a patient-centric label, which they and pharmacy staff alike preferred.

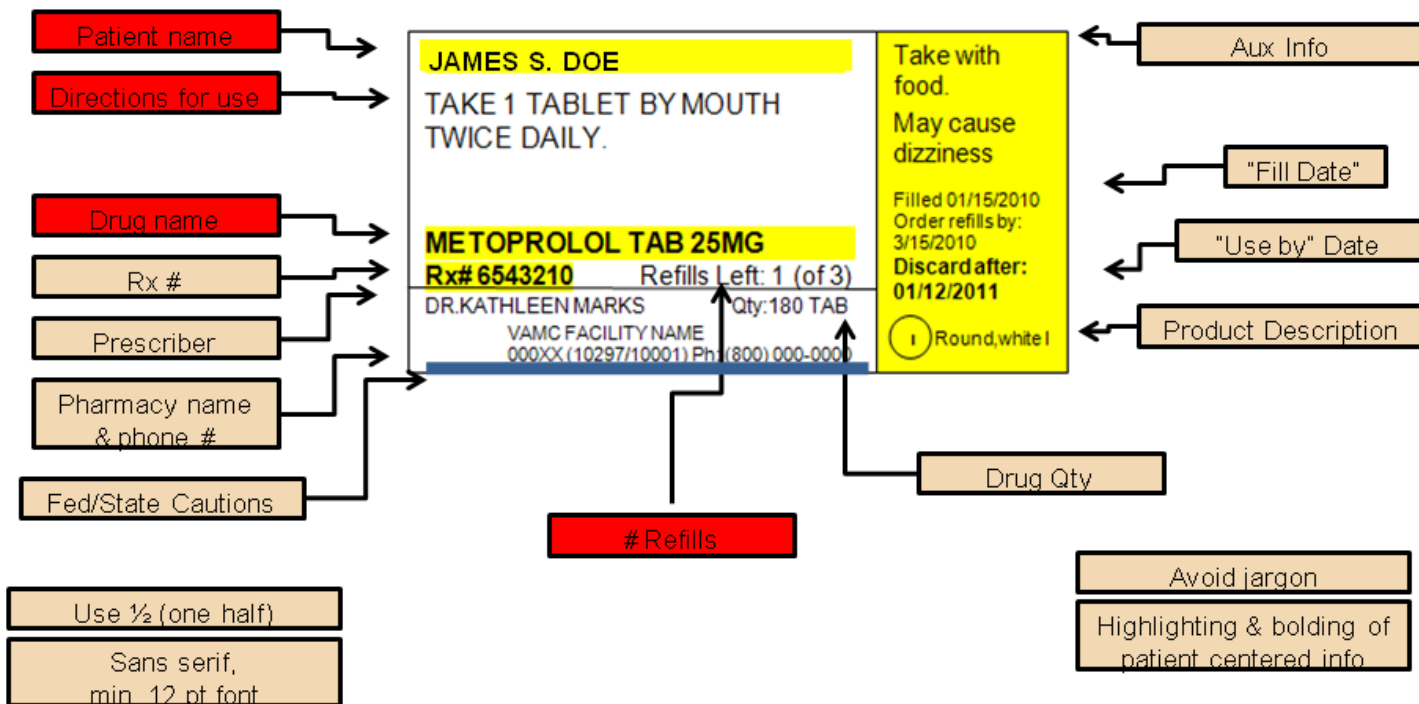
Some 25-58 percent of Veterans could not identify the correct number of pills to take when the word “meals” was used in the directions. Seventy percent of

the pharmacy staff, however, preferred the word “food.”

Other findings include: Veterans preferred having their name at the top of the label, a larger font size, bold type, and only the auxiliary area highlighted (not the entire label).

The study results will be used to develop a standardized VA prescription label. I also intend to publish a much more detailed paper on the study in the near future, but wanted to present some of the highlights in this issue of *TIPS*.

**Figure 3. VA patient-centric prescription label, preferred by 64 percent of Vets and 62 percent of pharmacy staff**



# Improving patient safety through human factors engineering and usability testing

Continued from page 1



Old “up” side      Redesigned “up” side  
(Reprinted with permission from Ethicon.)

Unnecessary distractions can also be found while observing health care professionals at work. For instance, numerous unnecessary incursions may be made into ICU rooms during central line placement. Signs warning people not to enter rooms while procedures are in progress are now in use in many hospitals. Observation of medication nurses also revealed how many interruptions occurred while medications were being passed. This led to signs, vests, jackets, etc., identifying the medication nurses and warning others not to bother them during these critical periods.

Confusing packaging, poor lighting, look-alike medications, poorly designed code and procedure carts, excessive workloads, and other factors can also be found by observing the performance of specific tasks. For example, observation of code cart use during several mock codes may highlight poor design issues and provide guidance for a more effective redesign. Usability testing should then be repeated to see if the changes were effective and, importantly, did not result in any unintended consequences.

## Usability testing

Virtually anything in patient care, from gowns to complex devices, is more likely to be used correctly if its use is intuitive, physically easy, and does not require excess mental work. Intuitive design takes advantage of the way we already think or perform tasks.

Things that are anti-intuitive, time-consuming, disrupt work flow, increase complexity, or show little obvious benefit to health care professionals, or patients, are less likely to be used or used correctly. Ask yourself, for example:

- Does a device add to the problem of carrying out a task or make it easier?
- Are there inherent problems with the design?
- Will there be special educational needs with the design?
- What are the consequences of incorrect use?

Usability testing may or may not have been done by the manufacturer. If it has been done, you should be able to request this information to help evaluate equipment before purchase or trials. If no testing has been done, usability problems may be found by simple usability testing at the hospital level.

More frequently “likability” tests are done before a purchase. These often include a potential end user being shown a device, given description of how it works, and then asked how he or she likes it; however, this type of input may not help find any problems with the design until it is actually used.

In contrast, simple usability testing can consist of giving a new device or kit to five or six potential end users, with only minimum instruction, and observing how they use it. This type of simple testing may give an indication of intuitive design or highlight potential safety issues. Usability testing on several different glucometers or connector caps, for example, may give a good indication of which product is easier to use and less likely to cause problems in the future.

Watching the end user hesitate or question the next step, pick up the wrong component, or use a device incorrectly, can give those responsible for in-servicing the product a “heads-up” on potential problems and where more intensive training might be more effectively concentrated.

Usability testing of kits and devices used for patient care can often be done on mannequins and/or simulators. Filming a usability test and then reviewing the results can help spot problems that may not have been apparent while observing an end user performing actions in real time. Usability testing may need prior approval by the facility research and development committee and its institutional review board, even though the products to be tested are already on the market and no patients will be involved.

Usability can also be very important when a new area of a hospital is being built or renovated. Many questions can arise, for instance:

- Are there easy and obvious ways for someone to summon help in the patient parking tower or other entryways?
- Will a gurney fit into the parking tower elevator along with the code team?
- Will the ICU rooms accommodate all of the equipment that may be needed and still permit easy access and egress in the event of an emergency?

- Where should the needle disposal box be located to make it most convenient for nurses?
- How should dialysis centers be designed so that nurses will always have a clear view of the needle access?

There are a multitude of HFE issues in hospital design, but many of them may not become obvious until health care professionals and patients are using a new or redesigned facility. Usability testing can be critical, since all concerned end up having to cope with a bad design that may never be changed—and fixing problems after a building is completed may require more funding than is available.

Those responsible for hospital design will frequently make partial mock-ups of patient rooms and exam rooms, and then ask a few health care professionals to review the mock-ups and see if they like the designs. This type of evaluation can also be misleading. Placing actual beds and appropriate equipment (or objects of comparable size) in sample rooms is a much better approach. Health care professionals can then attempt to carry out specific tasks, such as mobilizing the patient, transferring to a gurney, or running a mock code. The results can highlight potential problems with design before rooms are actually built, and avoid potential safety issues in the future.

## Further information on HFE and usability

Anderson, J., Gosbee, L.L., Bessesen, M., & Williams, L. (2010). Using Human Factors Engineering to Improve the Effectiveness of Infection Prevention and Control. *Critical Care Medicine*, 38(8),269-81.

Anderson, J., Bessesen, M., Wagner, J., & Williams, L. (2012). Usability in Hospitals. *Human Factors and Ergonomics in Manufacturing & Service Industries*. John Wiley & Sons. (Expected to be published in January)

## Checklists

Western Mich. U. Evaluation Center  
<http://www.wmich.edu/evalctr/checklists/about-checklists/>

AHRQ: What makes a good checklist  
<http://www.webmm.ahrq.gov/perspective.aspx?perspectiveID=92>

U. of Calgary: Surgical Safety Checklist  
<http://www.saferhealthcarenow.ca/EN/Interventions/SafeSurgery/Documents/Surgical%20Safety%20Checklist%20Human%20Factors%20Guidelines.pdf>